Original Article

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Physiotherapy Section

Prevalence of Hamstring Tightness and Shortness in Individuals with Prolapsed Intervertebral Disc: A Cross-sectional Study

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ABSTRACT

Introduction: Prolapsed Intervertebral Disc (PIVD) is one of the most typical musculoskeletal conditions affecting the lumbosacral spine and is considered a leading primary reason for low back pain and sciatica. Altered spinal biomechanics, neural tension, and muscle spasm, which are considered to be the primary factors in PIVD, may result in hamstring tightness and shortness. Hamstring tightness is defined as the reduction in the extensibility of the hamstring muscle group, which includes the biceps femoris, semitendinosus, and semimembranosus muscles. This hamstring tightness leads to hamstring shortness due to inactivation for prolonged time. However, shortening of the hamstring muscles would affect the flexibility of the pelvis and the lumbar region during any physical activity, thereby changing the mechanical forces and causing unnecessary stress, leading to pain. The secondary effects on the musculature need to be considered while evaluating the prevalence in patients with PIVD.

Aim: To assess the prevalence of hamstring tightness and hamstring shortness among individuals diagnosed with PIVD.

Materials and Methods: The present cross-sectional study was undertaken among 120 participants aged between 18 to 80 years with lumber PIVD was conducted from September 2025 to February 2026 at Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Mullana, Ambala, Haryana, India. Participants were asked for their consent before undergoing the Finger to Toe Touch Test (FTTT) and Active Knee Extension Test (AKET) for measuring hamstring flexibility. Visual Analogue Scale (VAS) was used for measuring pain intensity. Participants were considered to have hamstring shortness if the AKET was >23.4° for females and >33.0° for males. Participants were considered to be tight if AKET was >20° and FTTT was >10 cm. Descriptive statistics were used for calculating prevalence.

Results: Among the participants, 61 were males and 59 females with a median age of 41 years {Interquartile Range (IQR) 32-52}. Hamstring tightness was more prevalent in males 31 (50.82), while hamstring shortness was higher in females 45 (76.27). Overall prevalence of hamstring shortness and tightness was 60% and 36.66%, respectively.

Conclusion: According to the findings of the present study hamstring tightness and shortness are common in individuals with PIVD and may contribute to associated musculoskeletal dysfunction.

Keywords: Flexibility, Lower back pain, Musculoskeletal diseases, Muscle spasm, Young adult

INTRODUCTION

Disc herniation, also known as PIVD, is a musculoskeletal disorder that is a leading cause of lumbar radiculopathy and low back pain. It occurs when the nucleus pulposus herniates through an annulus fibrosus tear, resulting in the compression and inflammation of the nerve roots. Due to the increased stress and motion, the lumbar region is most commonly affected, especially between the L4-L5 and L5-S1 levels. PIVD usually affects individuals aged 30 to 50 years. It may lead to pain, paraesthesia, weakness, and disability, especially among the working population [1,2].

The PIVD in India is one of the most prevalent and costly spinal disorders, with an average of 52 to 60% of instances involving trauma, twisting, and heavy lifting, all of which are also commonly associated with occupational activity. The disease is more common in men than in women (2:1.36) and is seen primarily in people in their 3rd, 4th and 5th decades of life. While congenital anomalies such as short pedicles and connective tissue disorders are much less common, repetitive mechanical loading-along with faulty posture, obesity, and protracted sitting are recognised substantial risks [3].

Individuals living with persistent pain have been shown to have a high prevalence of hamstring tightness. Johnson and Thomas found a strong relationship between stiffness of the posterior chain and dysfunction and stiffness of the lumbar spine and hamstring flexibility [4]. However, most of the current literature is concerned with non specific low back pain rather than radiologically confirmed PIVD. Consequently, little is known about the prevalence of hamstring tightness and hamstring shortness in individuals with PIVD [5].

Hamstring tightness is defined as the reduction in the extensibility of the hamstring muscle group, which includes the biceps femoris, semitendinosus, and semimembranosus muscles. These muscles play an important role in maintaining the movement of the lumbar spine and the pelvis because they cross both the hip and the knee joints. Normally, for the lumbopelvic rhythm during activities such as bending, sitting, and walking, the hamstring muscles must be flexible. A restriction in hip flexion and knee extension because of decreased extensibility can result in abnormal lumbar motion and increased the spinal loads [6]. Prolonged inactivity associated with PIVD may contribute to hamstring shortening. However, shortening of the hamstring muscles would affect the flexibility of the pelvis and the lumbar region during any physical activity, thereby changing the mechanical forces and causing unnecessary stress, leading to pain [7].

To assess hamstring tightness, the FTTT and the AKE test is used, which have been proven to be valid and reliable [8,9].

It has been well documented that lumbar spine pathologies are associated with hamstring tightness. Hamstring tightness can alter spinal biomechanics, decrease lumbar lordosis, and result in posterior pelvic tilt, which increases stress on the intervertebral discs [10]. In patients with PIVD, these changes can contribute to existing disc degeneration and pain. Additionally, secondary hamstring tightness, fear of movement, and defensive muscle guarding can occur as a consequence of neural tension caused by nerve root compression [11].

Assessment of hamstring tightness is essential in the treatment and rehabilitation of patients with PIVD. Hamstring flexibility may play a role in pain, function, and treatment outcomes. Neural mobility and flexibility therapy may be beneficial to patients with PIVD with regard to lumbopelvic and functional results [12]. The prevalence of hamstring tightness in people with diagnosed PIVD is not well documented which can help in early prevention. Hence the present study aimed to assess prevalence of hamstring tightness among PIVD patients and its importance in comprehensive rehabilitation programs.

MATERIALS AND METHODS

The present cross-sectional study was conducted from September 2025 to February 2026 at Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Mullana, Ambala, Haryana, India. The study obtained approval from Institutional Ethical Committee of Maharishi Markandeshwar Institute of Medical Sciences and Research (MMIMSR) of Maharishi Markandeshwar (Deemed to be) University Mullana-Ambala, Haryana, India (IEC/2025/3084), following the principles outlined in the Declaration of Helsinki involving research into human subjects [13]. All individuals received written information about the study, outlining its voluntary nature, risks, benefits, and procedures to maintain confidentiality. All enrolled participants gave their written informed consent to take part.

Sample size calculation: The sample size was calculated using the formula $n=Z^2p(1-p)/d^2$ for prevalence studies. In the absence of reliable prior prevalence estimates, a prevalence of 50% was assumed to maximise the sample size, with a 95% confidence level and 10% absolute precision. The calculated minimum sample size was 96 participants. To improve the precision of estimates and account for potential exclusions, 120 participants were included in the study [14]. To account for exclusion and have sufficient statistical power, 120 participants diagnosed with PIVD were recruited using convenience sampling.

Inclusion criteria: The inclusion criteria for the study comprised pre-diagnosed cases of PIVD by neurologist within the age range of 18-80 years, presence of hamstring tightness defined as an AKE angle greater than 20° indicating restriction [15], and moderate pain intensity ranging from 3-8 on the Visual Analog Scale (VAS).

Exclusion criteria: The exclusion criteria included patients with severe neurological deficits such as significant motor weakness, sensory loss, or reflex abnormalities unrelated to PIVD [16]; individuals with inflammatory conditions like rheumatoid arthritis or ankylosing spondylitis that could influence mobility or pain perception [17]; those with a recent acute hamstring or other musculoskeletal injury within the past six weeks [17]; and individuals with psychiatric or cognitive impairments that would limit their ability to follow study instructions [17]; patients with uncontrolled systemic conditions such as uncontrolled diabetes or cardiovascular disorders that contraindicate exercise or manual therapy [13].

Study Procedure

A performa was utilised to collect demographic information such as age, sex, height, weight, Body Mass Index (BMI), address, occupation, duration of symptoms, and extent of disc involvement.

The VAS [17] was utilised to determine the level of pain, while the AKET [13] and FTTT [18] was used to determine the degree of hamstring tightness. The AKE test was performed on the limb demonstrating greater hamstring tightness not bilaterally whereas FTTT was taken for bilaterally.

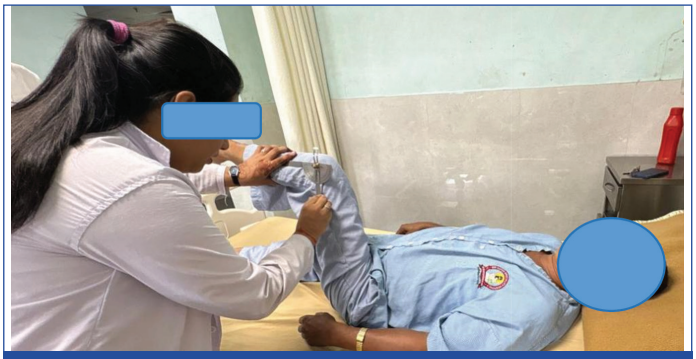
For hamstring shortness, the AKE angle was considered >23.4° for females and >33.0° for males [19] and for hamstring tightness the AKE angle was considered >20° in general [15] and FTTT was considered >10 cm [20].

Standardised verbal instructions were given to each participant, and all tests were conducted by the same examiner to ensure reliability of measurement. Adequate rest breaks were also provided to avoid fatigue or exacerbation of symptoms between tests.

To ensure anonymity, all collected data was coded and documented in a master data sheet. The incidence of hamstring tightness among PIVD patients was then determined by statistically analysing the collected data.

Hamstring tightness:

- **Active Knee Extension Test (AKET):** Hamstring tightness was measured using the standardised procedure of the AKE test. The pelvis was secured to the table in order to support it and control any accessories. To measure hip and knee range of motion, the greater trochanter, lateral malleolus, and lateral condyle of the femur were marked with a skin permanent marker. The fulcrum was centered on the lateral condyle of the femur, and the proximal arm of the goniometer was secured along the femur using the greater trochanter as a reference. After that, the participant was asked to extend the right lower extremity up to a mild stretch. Using a goniometer, the angle of knee flexion was determined. The distal arm and lower leg were lined up using the lateral malleolus as a reference. Intraclass Correlation Coefficients (ICC) is 0.79-0.91 [Table/Fig-1] [20,21].



[Table/Fig-1]: Active Knee Extension Test (AKET).

- **Finger to Toe Touch Test (FTTT):** The participants were instructed to flex their trunks toward their toes while keeping their arms and head relaxed after keeping their knees fully extended. The final position of flexion was shown by a sensation of tense muscles that seriously injured HM, and pictures were taken right then and there. If a person could reach less than 10 cm from their toes, they were considered to have normal flexibility; if they could stay more than 10 cm from the ground, they were considered to have impaired flexibility. The distance between the fingertips and the toes (in centimetres) was determined using a known linear measure that was placed in the subjects' field of vision. The participants were reminded to keep their knees extended. ICC is 0.99 [Table/Fig-2] [18].

Pain intensity: The VAS was used to assess pain intensity. It was a 10 cm horizontal line with "no pain" at one end and "worst imaginable pain" at the other. The patient was asked to mark their current leg pain on the line. VAS is a reliable measure of pain intensity, with a minimal clinically significant difference of 1.8 to 1.9 cm [22].

STATISTICAL ANALYSIS

Data collection and analysis were performed using Statistical Package for Social Sciences (SPSS) (version 26). Since the data

[Table/Fig-2]: Finger to Toe Touch Test (FTTT).

was not normally distributed, it was reported as median with IQR. Demographic and hamstring tightness prevalence data were analysed and presented as percentages. Additionally, a 95% Confidence Interval (CI) was calculated for the prevalence values.

The prevalence of hamstring tightness in PIVD patients was analysed by age-group (18-29, 30-39, 40-49, 50-69, 70-80), gender, and degree of shortness.

RESULTS

There were 120 patients in all, 61 (50.83%) were males and 59 (49.17%) were females. The median age was 41 (IQR 32-52), and their age varied from 18 to 80. Specific demographic information is presented in [Table/Fig-3].

Parameters		Value
Sex	Male	61 (51%)
	Female	59 (49%)
Age (years)		41 (32-52); 18-80
BMI (Kg/m^2)		24 (22-25)
AKE (^{o})		63 (55-65)
VAS		7 (6-8)
FTTRT (cm)		35 (27-46)
FTTLT (cm)		35 (26-48)

[Table/Fig-3]: Demographic data of PIVD patients (N=120).
*BMI: Body mass index; AKE: Active knee extension; VAS: Visual analogue scale; FTTRT: Finger to toe touch for right leg; and FTTLT: Finger to toe touch for left leg.

The age group of 30-39 years had the greatest number of patients (n=33), followed by 40-49-year-old (n=32), 50-69 years (n=29), 18-29 years (n=21), and 70-80 years (n=5).

Hamstring tightness was found to be a common finding in all age groups, but it was most prevalent in the 70-80 age group (100%), followed by the 40-49 age group (87.5%), 18-29 age group (85.7%), 30-39 age group (84.8%), and 50-69 age group (82.8%) in [Table/Fig-4].

Hamstring tightness was observed in 44 (36.7%) participants, (95% CI: 28.0-45.3), while hamstring shortness was present in 72 (60%) participants, (95% CI: 51.2-68.8). Among males, the prevalence of hamstring tightness and shortness was 50.82% (95% CI: 38.3-63.4) and 44.26% (95% CI: 31.8-56.7), respectively. Among females,

Age group (years)	PIVD patients (n)	Prevalence of hamstring tightness n (%)	Prevalence of hamstring shortness male n (%)	Prevalence of hamstring shortness female n (%)
18-29	21	18 (85.7) (70.7-100.0)	6 (54.5) (25.1-83.9)	8 (80) (55.2-100.0)
30-39	33	28 (84.8) (72.6-97.1)	10 (58.8) (35.4-82.2)	13 (81.3) (62.1-100.0)
40-49	32	28 (87.5) (76.0-99.0)	4 (30.8) (5.7-55.8)	16 (84.2) (67.8-100.0)
50-69	29	24 (82.8) (69.1-96.6)	4 (28.6) (5.0-52.1)	8 (66.7) (40.0-93.3)
70-80	5	5 (100) (100-100)	3 (60) (17.1-100.0)	-

[Table/Fig-4]: Prevalence of hamstring tightness and shortness by various age group.

the prevalence was 22.03% (95% CI: 11.5-32.6) for tightness and 76.3% (95% CI: 65.4-87.1) for shortness [Table/Fig-5].

Gender	PIVD patients (N)	Share of total (%)	Prevalence of hamstring tightness (%)	Prevalence of hamstring shortness (%)
All	120	100	44 (36.67) (28.0-45.3)	72 (60.00) (51.2-68.8)
Male	61	50.8	31 (50.82) (38.3-63.4)	27 (44.26) (31.8-56.7)
Female	59	49.2	13 (22.03) (11.5-32.6)	45 (76.27) (65.4-87.1)

[Table/Fig-5]: Prevalence of hamstring tightness and shortness by gender basis.
*PIVD: Prolapsed intervertebral disc; Values presented as n (%); ( )-95%CI

DISCUSSION

The present study identified a high prevalence of hamstring tightness (36.66%) and hamstring shortness (60%) in individuals with PIVD, as assessed using the FTTT and AKET. These findings suggest an association between reduced hamstring flexibility and PIVD; however, given the cross-sectional design, causal relationships cannot be established.

In comparison of the present study, one study reported that hamstring muscle tightness was more common among physical therapists (30.63%) based on the findings from four studies, whereas technicians had the least frequency. As a result, for instance, the 5.75% disparity in the findings shows that the cause of this injury lies in the difference between their job descriptions [23].

On the other hand, one study revealed that there was a high frequency of hamstring muscle tightness in male athletes who were engaged in contact sports than in those athletes who played other sports. No association was observed between the tightness of the hamstrings and body height or the period of rest in between playing sports. Consequently, athletes involved in contact sports should undertake precautions to prevent hamstring muscle tightness [24].

Other researchers conducting a cross-sectional study noted that hamstrings' tightness is prevalent in young adults aged between 18-25 years (82%). Furthermore, the prevalence of the condition was more among females than males [25].

Other cross-sectional study revealed that college students were more likely to experience hamstring tightness with AKE angles ranges between 30^o-45^o. Tightness is more common in females, with a prevalence of 96% compared to 4% in males [26].

The prevalence observed in the present study is consistent with previous literature reporting reduced hamstring flexibility in individuals with lumbar spine disorders. Similar findings have been reported in studies involving patients with lumbar disc herniation, where hamstring tightness was more pronounced compared to asymptomatic individuals [27]. However, some studies in general low back pain populations have reported varying prevalence rates, which may be attributed to differences in sample characteristics, diagnostic

criteria, and assessment methods. This highlights the importance of examining specific clinical populations such as PIVD separately.

From a biomechanical perspective, earlier studies have suggested that hamstring tightness may influence lumbopelvic rhythm by limiting anterior pelvic tilt and increasing lumbar flexion during trunk movements [28,29]. While such mechanisms are widely discussed in the literature, the current study did not directly assess spinal kinematics; therefore, these explanations should be interpreted cautiously and only as potential contributing factors rather than confirmed mechanisms.

Neurodynamic factors may also contribute to reduced hamstring flexibility in individuals with PIVD. Previous studies have demonstrated that patients with lumbar radiculopathy exhibit increased mechanosensitivity during neural tension tests such as the Straight Leg Raise (SLR) [29,30]. This may lead to an earlier perception of stretch or discomfort during flexibility assessments, even in the absence of true muscle shortening. The co-existence of hamstring shortness in the present study, however, suggests that both muscular and neural components may be involved.

The use of both AKE and FTTT in the present study allowed assessment of isolated hamstring extensibility as well as overall posterior chain flexibility. The consistency of findings across both measures supports the presence of reduced flexibility; however, it should be noted that the FTTT may also be influenced by spinal and fascial factors, which could affect interpretation.

In comparison with existing studies, the present findings reinforce the association between hamstring flexibility and lumbar spine conditions, but do not establish whether hamstring tightness is a cause or consequence of PIVD. Furthermore, unlike some previous studies, the current study did not analyse associations with demographic or clinical variables such as age, gender, BMI, or pain severity, which limits deeper interpretation of the findings.

Clinically, while previous literature suggests that improving hamstring flexibility may benefit patients with low back pain by enhancing pelvic mobility and functional performance [31,32], the present study does not provide evidence to support specific treatment recommendations. Therefore, any clinical implications should be interpreted with caution.

In summary, the present study demonstrates a notable prevalence of hamstring tightness and shortness in individuals with PIVD and supports existing evidence of an association between hamstring flexibility and lumbar spine pathology. Future studies incorporating inferential analysis and longitudinal designs are required to better understand the nature and clinical significance of this relationship.

Limitation(s)

There are several limitations of the present study that should be considered while interpreting the findings. First, due to the cross-sectional design, causal relationships between hamstring tightness and PIVD cannot be established. Since data were collected at a single point in time, it remains unclear whether hamstring tightness is a contributing factor to PIVD or a consequence of the condition. Longitudinal studies are required to better understand the direction of this relationship.

Second, the relatively small sample size and recruitment from a single clinical setting may limit the generalisability of the findings. Additionally, participants were not stratified based on the level, type, or severity of PIVD, which could influence hamstring flexibility outcomes. The absence of severity classification restricts a more detailed understanding of how disc pathology may relate to the degree of hamstring tightness.

Third, the measurements in the present study were performed by a single assessor, which may introduce measurement bias and affect the reliability of the results. The lack of inter-rater reliability assessment further limits the objectivity of the findings.

Additionally, inferential statistical analyses examining associations between hamstring tightness and demographic or clinical variables such as age, gender, BMI, and pain severity were not performed, which limits deeper interpretation of the findings. Finally, other potentially influencing factors such as pain severity, fear-avoidance behavior, prior physiotherapy treatment, and lifestyle variables were not evaluated, which may have affected the observed outcomes.

CONCLUSION(S)

Based on the current study, hamstring tightness is one of the most frequent presenting complaints of PIVD disease. Based on the outcome of the AKET and FTTT, it was revealed that this group of patients often has a deficit in hamstring flexibility. The outcome of this study emphasises the importance of assessing hamstring flexibility in the diagnosis of patients with PIVD. Patients with PIVD can also benefit more if, specific stretching and flexibility exercises are included in physiotherapy programs.

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